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Pimiento Production In Georgia

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Pimiento Production in Georgia[1]

By A. H. Dempsey and B. B. Brantley

INTRODUCTION

For more than 25 years, the pimiento has been one of the most important vegetable crops for canning in Georgia. Georgia farmers grow approximately 75 percent of the pimientos produced in the United States. Sixteen plants in Georgia process approximately 90 percent of all the pimientos used in the United States. During the period from 1947 through 1951, an average of about 20,000 acres was planted annually in the State, with an all-time high of 32,000 acres devoted to this crop and a yield of 45,120 tons recorded in 1950(11). The number of acres harvested, average yield per acre, total production, price per ton, and total value of pimientos for the period from 1940 through 1952 are shown in Table 1,(8).

Table 1. Pimientos (For Processing): Acreage, Yield, Production, and Value (1940-1952) Georgia[1]

Year	Harvested acres	Yield per acre	Production	Price per ton	Total value
	number	tons	tons	dollars	1,000 dol.
1940	14,800	0.67	9,920	26.00	258
1941	12,000	0.78	9,360	34.00	318
1942	13,500	1.40	18,900	41.55	785
1943	8,700	0.90	7,830	50.00	392
1944	6,100	1.20	7,320	55.00	403
1945	8,500	1.30	11,050	60.00	663
1946	13,000	1.42	18,460	60.00	1,108
1947	16,000	0.98	15,680	60.00	941
1948	14,300	1.25	17,880	70.00	1,252
1949	24,500	0.97	23,565	70.00	1,664
1950	32,000	1.41	45,120	70.00	3,150
1951	18,000	0.85	15,300	75.00	1,148
1952	13,000	0.75	9,750	80.00	784

1. Data from Georgia Crop Reporting Service.

The yields of pimientos vary from year to year, depending on growing conditions and care given to the crop. They usually range from one-half to three tons with occasional yields up to five tons of marketable fruit per acre; however, the average yield for the State is approximately one ton per acre. Obviously there is a need in many instances for growers to use better cultural methods. Improved production methods are essential to successful pimiento production. As a rule, with favorable weather conditions, the greater the investment of time and money in the proper construction and

1. Revision of Bulletin 259. Pimiento Production in Georgia by F. F. Cowart and A. H. Dempsey.

management of plant beds, production of disease free seed and healthy plants, and the use of proper cultural methods, the higher are the net returns from this crop.

USE AND VALUE AS A FOOD

Because of their brilliant red color and sweet flavor, pimientos are often used to enhance the qualities of other foods. When incorporated into sauces, meat or fish dishes, cheese, or salads, pimientos add their characteristic flavor and a dash of color as well. They are also attractive garnishes, especially for salads and garnishes.

Fresh pimientos, although succulent and delicious, are not commonly used in this country. Most of the crop enters distribution channels only after being processed. Canned pimientos are available for general use, but a large share of the crop each year goes to the food manufacturers either in canned, brined, or frozen form for the production of table-ready meats, pimiento cheese, and stuffed olives.

In addition to their attractive and flavorful qualities, their exceptionally high content of vitamin C deserves consideration in assessing the value of pimientos as a food. Canned pimientos contain on the average about 160 mg. of vitamin C per 100 grams. Even small servings will, therefore, contain appreciable amounts of this vitamin. A one-ounce serving of canned pimiento will provide about one-half of the daily allowance of vitamin C recommended for an adult (75 mg.). It should be noted that the vitamin C content of brined pimientos often used in making pimiento cheese or in stuffing olives is negligible.

VARIETIES

Perfection, and Truhart Perfection which was released by the Georgia Experiment Station in 1943, are the only pimiento varieties grown for canning. The Perfection had its beginning in 1912 when S. D. Riegel, Experiment, Georgia, found in a planting of pimientos produced from seed imported from Spain one plant which bore fruits that were superior in several characters to those of the rest of the field. Because of the good qualities of this new type, it was given the name "Perfection". Seed were saved from all the fruits on this one plant and sowed the following year for increase, which served as the beginning for the now widely known Perfection variety.

Although the original fruits of the Perfection variety were better in many respects than those of the Spanish type, they were decidedly lacking in uniformity of shape and color. In 1936, a definite type improvement program was started with the pimiento at this Station. A superior strain was developed as a result of this program. The fruits are heart-shaped, rounded at the stem end which prevents the collection of water, thick-walled, heavy, and extremely dark red

in color when ripe. Under good growing conditions and when properly cared for, the plants are about three feet in height, upright in growth but well branched, which provides a large amount of foliage for the protection of the fruits against sunscald. This improved variety was named Truhart Perfection and was described in detail by Cochran (4).

Work is now in progress at the Georgia Experiment Station to develop a high yielding, better quality, and disease-resistant variety.

SEED SELECTION

Good seed is the first essential to profitable pimiento production. Even though the grower might give the closest attention to all factors of production, little success can be expected when the beds are planted with poor seed.

Most all pimiento canners save their own seed from year to year. The seed should be removed before the fruits are fire-roasted or oil-scalded. Cochran (2) has shown that pimiento seed taken from fire-roasted or oil-scalded fruits germinate poorly and produce seedlings which are abnormal in appearance and worthless for fruit production. When buying seed at planting time, the grower should be certain that he obtains the best available; i.e., seeds that have been treated for disease control and have been taken from disease-free, desirable type fruits before the fruits are heated to remove their skins. Frequently, cheap seed can be bought, but they usually prove to be an expensive item. If the grower is not content with the seed offered by the canner, he may save his own. If this is done, however, a rather rigid procedure must be followed. The field should be inspected early in the season, prior to the ripening of the first fruits. The best plants should be selected and marked. After a period of about two weeks, the field should be inspected again and any of the marked plants that are undesirable should be discarded, leaving only those of good type with a heavy set of well-shaped fruits. After ripening, the seed should be removed from all desirable fruits and treated as outlined under "Seed Treatment". Best results are obtained, if rigid selection is practiced year after year, keeping in mind at all times the ideal plant and fruit characters.

Tests have shown that pepper seed remain viable longer when stored at room temperature, if placed in open containers or in clean bags that permit air circulation. The temperature should be kept fairly low and uniform and the relative humidity should be low. As soon as the seed have been removed from the fruits, they should be treated and dried and placed in clean bags for storage as outlined above. Under such conditions, good seed should remain viable for two to three years. However, it is advisable to have a germination test made before planting to determine the percentage of viable seed.

METHODS OF GROWING PLANTS

It is common practice for the pimiento grower to plant enough seed to produce sufficient plants for his contract acreage with some extra for replanting. To be assured of their desired acreage, however, most canneries grow supplemental plants as well.

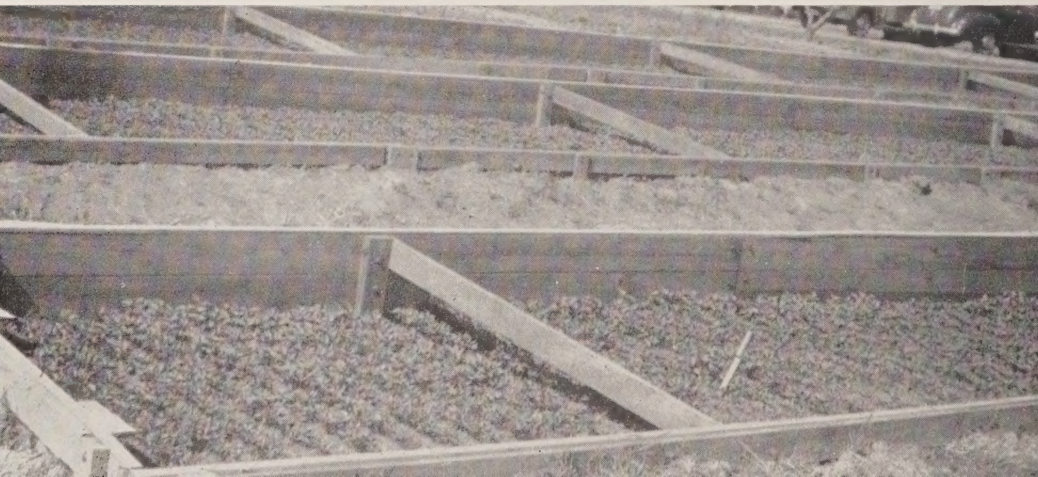
There are three general methods used in Georgia to produce pimiento plants, and the best one to follow depends largely on the section in which the grower is located. Pimiento plants are reasonably slow growing. Plants must be grown in a heated bed in all sections of the state, except the extreme southern part, in order to obtain plants sufficiently early in the season to insure a good stand and good yields.

The Hotbed Method. This method is generally used by plant growers in the central part of the State. In order to have plants available for early setting, seed should be sown in four to six-inch rows in a well prepared and well-heated hotbed during February or early March, planting from one-half to one pound of seed for each acre of pepper that is to be set in the field.

The bed should be located preferably on a southern slope and out of the path of prevailing winter winds. There should be good, natural drainage, an abundance of sunlight, and a convenient water supply. Where unweathered stable manure is available, it may be used as a source of heat for these beds. If available, other sources include electricity, steam, hot water, and flues.

Where manure is used, best results may be expected when the bed is dug out to at least 18 inches below the soil surface. This excavation requires a rather large volume of manure, but has the advantage of insuring a fairly high and uniform temperature. Where the bed is to be made permanent, a frame should be constructed, preferably

FIGURE 1. *Electrically-heated hotbed with young pimiento plants.*



out of good lumber fitted into the excavation. If the gable type hotbed is constructed, the frame should extend from 8 to 12 inches above the soil on both sides and be built to a pitch several inches higher in the center of either end. This allows the insertion of a ridge pole over which the cover is stretched to shed rain. If the hip type is desired, the north side of the frame should extend 18 inches above the ground line, and the south side at least eight inches above to give the cover sufficient pitch to shed water adequately.

The excavated part of the bed should be filled with stable manure, moistened, and packed well to within five inches of the ground line. The remainder of the hole should be filled with either well-screened composted soil or "woods earth," sometimes called "leaf mold". This constitutes the seedbed and should be prepared a few days before the seed are planted.

When such soil mixtures, as described above, are used in the bed, little, if any, commercial fertilizer need be applied until the plants are several inches high. At this time a light application of a complete fertilizer, analyzing approximately eight percent nitrogen, eight percent phosphoric acid, and eight percent potash (8-8-8) should be worked into the bed, which will usually carry the plants through in good shape to the pulling stage. The mixture should be applied between the plant rows at a rate of one pound per each 30 square feet of hotbed space. When ordinary field soil is used in the bed, it should be well fertilized before the seed are sown, as well as at the time mentioned above. A fertilizer mixture containing a smaller amount of nitrogen, such as 4-8-8, should be used before sowing the seed in order to avoid the possibility of burning the small tender plants as they emerge from the soil. This should be applied at the rate of one pound to each 12 square feet of bed space.

Where electricity, steam, or hot water is used as a source of heat, no excavation is needed other than enough to steady the framing, as the bed is made on the surface of the soil.

New, unbleached sheeting, with at least 56 threads to the inch, may be used for a hotbed cover. This material is more effective for holding heat and keeping out rain when it is treated with a solution containing one gallon of linseed, or lubricating oil, and four pounds of melted paraffin. For best results, the sheet should be stretched tightly and the solution applied with a paint brush while warm. In using treated sheets, it is important that the beds be examined at frequent intervals to see that they do not dry out.

Plant beds may be covered with standard glass sash or various kinds of glass substitutes such as cellulose acetate treated cord or wire built into convenient size frames.

Information on the construction of hotbeds may be found in Georgia Agricultural Extension Service Bulletin No. 560, "Plant Beds for Early Plants".

The Cold-Frame Method. This method is used to some extent by growers in south Georgia. Where properly handled, good plants can be produced by this method at a relatively low cost. It is important that the bed be located in a protected place where it can receive as much of the daily sunshine as possible, since this is the only source of heat for warming the soil. Well-seasoned and well-braced 1 x 12-inch boards set up on edge make excellent sides and ends for the frames. These boards should be given one or two coats of paint or treated with copper naphthenate or similar material. Treatment with copper naphthenate should be done three or four weeks before planting to avoid injury to the plants.

The soil to be used should be turned, cleaned of tree and grass roots, fertilized, and smoothed several days in advance of planting and before the cold frame is assembled in place.

The seed should be sown about February 15 in rows six inches apart and the beds covered with the type of sheeting material described under the hotbed method. Due to nematode infestation in the soils of the South, it is recommended that the beds be placed on newly cleared ground each year, if possible, or the soil be treated with methyl bromide (MC-2) or a mixture of dichloropropene and dichloropropane (D-D). If the manufacturer's instructions are followed closely, these materials will effectively reduce the nematode population. The selection of new soil each year for the cold-frame location is also advantageous as a means of reducing the loss of plants due to certain diseases.

The Open-Field Method. In the vegetable plant-growing area in south Georgia, the open-field method of growing pimiento plants has been used successfully. More recently, pimiento processors have grown a considerable quantity of these plants in central Florida. When making preparations to produce plants by this method, if on new ground, it is important that the soil be cleared during the early winter of all large roots, stumps, and trash. Afterward, it should be turned deeply and disked well, as this is to constitute the seedbed. Just prior to planting the seed, the land should be disked again and dragged level. The open-field method has some advantages, even over the cold-frame method in that the plants are better hardened and do not suffer from "blue mold" as do those grown under cover. When using this method, the care of the plants is the same as for any other field crop as far as cultivation is concerned. Pepper plants are quite tender, and extra care should be exercised in keeping them free of weeds.

CARE OF PLANTS IN THE BEDS

With the hotbed and cold-frame methods, enough plants for one acre can be grown in a bed area of 100 square feet; however, many growers prefer larger beds even with a small acreage, so that extra plants will be available for replanting or selling.

When seedbed preparation is completed, the soil should be thoroughly soaked about two days before planting. After planting the seed, the soil should be watered again with a sprinkling can or garden hose, taking care to distribute the water uniformly over the entire bed surface. If the temperature of the hotbed is maintained between 70 and 80 degrees F. and viable seed are used, the young plants should be up within 10 to 15 days. Under cold-frame conditions, where no extra heat is used, it often takes the young seedlings as long as 18 to 21 days to emerge. After they are up, it is necessary to uncover the beds for several hours on bright, sunny days to reduce the air temperature, to allow for the escape of excess moisture from the bed, and to let in light. The beds should be covered approximately two hours before sundown. Watering should be done only often enough to keep the plants growing, since excess moisture encourages the growth of "damping-off" and "blue mold" fungi. Watering should be done preferably during the morning on warm days without chilling the plants. As the season advances, the plants may be uncovered more during the day. For about 15 days before transplanting the plants to the field, the covers should be left off the beds both day and night, except in periods of adverse weather. Water should be withheld, even to the wilting point, during this period so that growth is checked, and the plants become well-hardened, and thereby able to withstand the shock of transplanting.

SOILS

When properly managed, it is possible to produce good yields of pimientos on almost any of the soil types in Georgia. However, best results may be expected on those that are well drained, fertile, and with fair amounts of organic matter. The lighter or sandy soils usually require more fertilizer for maximum production than do the heavier types. Good pimiento yields may be obtained on a number of different soil types. The most commonly used are those of the Madison, Lloyd, Cecil, Greenville, and Orangeburg series.

Regardless of the soil type selected for this crop, the soil should be kept in as good physical condition as possible. This not only assures better growing conditions for the plants, but provides conditions for easier and thorough cultivation. As a general rule, the gray sandy soils are easier to work and keep free of grass and weeds because they can be plowed sooner after heavy rains. Heavy-textured soils should not be worked when too wet as this will cause them to

bake upon drying, and result in many large clods or lumps, which are always difficult to pulverize. The time of plowing is not as important with sandier soils.

Although pimientos are not as sensitive to soil acidity as some vegetable crops, preliminary work conducted at this Station indicates that a pH value ranging from 5.5 to 6.5 is most desirable for the growth of this crop. These results are in agreement with those of Cooper (6) who recommends this same soil acidity range as being ideal for the growth of peppers in general.

COVER CROPS AND ROTATIONS

Turning under large quantities of such rapid-growing cover crops as oats, rye, vetch, Austrian winter peas, crotalaria, lespedeza, etc. if well managed, will bring about numerous favorable effects, and will aid materially in maintaining, or raising, the crop-producing capacity of the soil. If the crop turned under is a large legume, and the nodule organisms have been active, the store of soil nitrogen is markedly augmented. Legume, as well as non-legume covers, aid materially in erosion control and add organic matter to the soil. Organic matter increases the absorptive capacity of the soil and promotes aeration, drainage, and other conditions that are extremely important in successful plant growth. It serves to bind together a sandy soil and increases its water-holding capacity. In clay soil it promotes a crumb structure, and practically determines the fitness of such a soil to function as a foothold for plants. Organic matter also acts as a food for soil organisms, and tends to stimulate biological changes to a marked degree, which are of special importance in the production of available plant nutrients.

Crop rotation is important, and is necessary with pimientos in the control of certain plant diseases. Many growers, in finding that a certain piece of land on the farm produces good yields of pimientos, are prone to plant the same field to this crop year after year. This practice leads to disastrous results because diseases increase rapidly.

For this reason, rotations should be worked out with crops that are either immune, or highly resistant, to the diseases of pimientos. The same soil should not be planted to pimientos more than once in three years. Suggested rotations for pimientos are as follows:

(1) First year—Pimientos
Second year—Cotton, followed by fall-sown crimson clover, vetch, Austrian peas, rye, or a combination of these.
Third year—Corn
Fourth year—Pimientos

(2) First year—Pimientos
Second year—Small grain, lespedeza sown in the spring

Third year—Corn, followed by a small grain cover crop in the fall
Fourth year—Pimientos

The row crops should be kept as free of weeds as possible, as many of these are hosts to destructive pimiento diseases.

LAND PREPARATION

Poor plant growth and low yields are often brought about by improper land preparation. Frequently some growers wait too late in the spring to turn their land with the result that the natural or planted covers do not have sufficient time to decompose before the plants are ready for transplanting to the field. Others tend to turn the land too shallow, which results in somewhat restricted root development, especially in the heavier soil types. Where a good cover is present, it should be turned deeply and disked well, preferably in early February while the growth is still succulent and easy to incorporate into the soil. With sufficient soil moisture present, bacterial action will usually be such that turned materials will decompose sufficiently within four or five weeks. A few days before setting, the land should be disked and harrowed with a spike-tooth harrow in order to leave the surface smooth and free of large clods. Rows are usually spaced three and a half feet apart, which is common with many other row crops produced in Georgia. The rows are layed off with a shovel-like plow which leaves a furrow about 10 inches wide and four inches deep. Fertilizer is applied in this furrow, using implements that are employed in fertilizer placement with cotton, corn, and other row crops.

FERTILIZERS

Commercial fertilizer is a large item in the cost of pimiento production as the plants must be constantly supplied with nutrients in order to produce maximum yields.

Several different fertilizer mixtures may be used with good results, provided they are applied at a rate to furnish about the same amounts of plant nutrients. In order to supply the necessary amount of plant nutrients, a 4-8-8 fertilizer mixture should be applied at a rate of 600 to 800 pounds per acre in the row before planting, and the plants side dressed twice with 150 to 200 pounds of a 14-0-14 fertilizer per acre (5). The first side dressing should be applied when the first fruits set and the second about eight weeks later.

On the lighter soils of south Georgia, 1000 to 1200 pounds per acre of 4-8-8 fertilizer may be required to obtain maximum yields. One-half of this fertilizer should be applied in row before planting and one-half used as side dressing. The plants should also be side dressed twice as outlined above.

TRANSPLANTING TO THE FIELD

Pimiento plants should not be set in the field until after danger of killing frost has passed. However, experimental evidence has consistently shown that in order to obtain maximum yields, they should be transplanted to the field as soon after this date as possible. Weather records indicate that this date in central Georgia is about April 15 and for many sections of south Georgia, April 1 or earlier.

During the late afternoon of the day before transplanting, the plant beds should be thoroughly soaked with water to facilitate pulling and to reduce the amount of root pruning that usually occurs. If the soil is moist, a small amount will adhere to the roots and prevent them from drying so rapidly. This also aids in rapid root replacement after transplanting. Immediately before the plants are set, a small ridge is prepared in the previously marked and fertilized rows. The soil along the plant row must be loosened to a depth of several inches in order to set the plants at the required depth. If possible, transplanting to the field should be done during the afternoon or on a cloudy day, preferably when the soil is damp and in good physical condition. All plants should be watered when set out, regardless of the moisture content of the soil. This operation settles the soil around the roots and assures rapid establishment of the plant. It is especially important to firm the soil well around the roots of the plants as they are being set. Extra soil should be pulled about the base of the plants to give them additional support and to prevent excessive loss of moisture from the root zone. Replanting should be done three or four days after the original setting of the plants.

FIGURE 2. *Hand transplanter.*

Preliminary investigations at this Station indicate that the use of transplanter solutions are desirable under some conditions. Good results may be obtained by using 2.7 pounds of Ammo-Phos plus 1.3 pounds of potassium nitrate to 50 gallons of water, or commercial starter solutions such as Gro-Crop and VHPF. These starter solutions should be applied at the rate of one-half pint per plant.

A hand transplanter is most commonly used for setting the plants in the field. Where a large acreage is to be planted, horse-drawn or tractor-drawn transplanters may be used, if soil conditions permit. Generally, these machine transplanters cannot be used successfully

on the heavy soils in the Piedmont, but can be used on the more friable soils in the Coastal Plain area.

The spacing given the plants in the row depends to a large extent on the fertility of the soil. Grower experience indicates that the most satisfactory spacing of plants within the row is two and a half to three feet apart with rows three and a half to four feet apart. A two-and-a-half-foot spacing requires 4,978 and a three-foot spacing 4,149 plants per acre when rows are three and one-half feet apart. Closer spaced plants usually grow too tall and are easily broken by wind and careless plowing. In addition, the fruits from such plants are, in many instances, off-type in shape, smaller in size, and have thinner walls than those from plants grown under less crowded conditions.

DIRECT SEEDING TO THE FIELD

In certain sections of the State where weather conditions permit, some growers plant pimiento seed directly to the field where the crop is to be grown rather than transplanting the plants as discussed previously. Seed are drilled in rows about 48 inches apart on raised beds and covered with about a half inch of soil. When the plants are eight to ten inches high they are carefully thinned to the desired distance. Plants that are pulled in the thinning operation may be sold or used for replanting.

This method of growing the crop has been used with varying degrees of success in some parts of south Georgia. In these areas, the sandy soils warm up readily in the spring, thus seed germination is not greatly delayed.

CULTIVATION

Once root replacement begins and the plants become established in the field, they should be given a shallow cultivation to free the soil of all vegetation which may seriously compete with them for nutrients. The pimiento has a fairly shallow root system; therefore, deep cultivation should be discouraged at all times (3). This also brings moist soil to the surface, the water from which is readily lost by evaporation, especially during hot, dry weather. Hand hoeing is required to control vegetation between the plants in the row. It is important that the crop be kept clean by frequent cultivation and hoeing, especially during the early stages of growth. Since the plants continue to grow and produce fruit until frost, it usually pays to keep them worked until late summer.

The tools required for the proper cultivation of pimientos consist mainly of those used in general farming. Several sizes of flat scrapes, together with a medium-sized sharp scooter, make one of the most useful types of plows that can be had for this particular crop.

Pimiento plants are easily broken; therefore, care must be exercised when they are plowed and hoed. After they begin blooming

and setting fruits, and before they become very large, the singletree of the plow stock should be shortened so it will not strike the lower limbs upon cultivating the crop or turning at the ends of the rows. Once a plant is broken it may not necessarily die, but usually will not make sufficient growth to mature many fruits before being killed by frost.

HARVESTING AND GRADING

The stage at which pimientos are harvested is important in determining the quality of the canned fruit. Maximum quality is reached when the fruits are allowed to remain on the plants until the color becomes dark red. Under good conditions and when well cared for, ripe fruits can be picked from 90 to 110 days after the plants have been set in the field, which is usually the last week of July in central Georgia. However, fairly ripe fruits can remain on the plants for some time without serious deterioration except during wet weather when they crack badly. During good weather they may be left until there are enough to make the picking of the whole field worthwhile.

At one time, bushel and half-bushel baskets were used extensively in this State for picking pimientos, but since they are troublesome to handle and limit the picker to the use of only one hand, ordinary cotton-picking sacks are now in general use. These sacks, being strapped over the pickers' shoulders, allow the use of both hands in the operation, are easier to carry, and have a greater capacity than baskets. From 40 to 50 pounds of ripe fruits may be carried in such sacks without bruising if handled carefully. When full, the contents are emptied into larger bags, and hauled to a central grading place on the farm where diseased, unripened, or undersized fruits are separated from the larger ones; or they are hauled directly to the cannery. In either case, the fruit is usually bought by grade at the processing plant. Fruits of the No. 1 grade consist of those which measure at least two inches in diameter, are free from visible diseases, and have a dark red color. This grade usually brings ten dollars per ton more than fruits of the No. 2 grade, which also must be of good color, free from disease, and at least one and five-eighths inches in diameter.

As a general rule, the grower picks his crop only once each week during good weather, and delivers it to the cannery on designated days. During seasons of heavy rainfall, the fruits often have to be picked before they attain a full red color in order to prevent excessive cracking. Such fruits should be spread out in a dry room until they develop a red color. From 14 to 18 pickings of ripe fruits are generally made during the season, depending on the date of the first killing frost.

LABOR REQUIREMENTS AND PRODUCTION COSTS

On farms using only mule power for all operations, an average of 159.1 hours of man labor and 84.1 hours of mule labor are required to produce an acre of pimientos. On farms using both mule and tractor power, 146.3 hours of man labor, 37.4 hours of mule labor, and 2.0 hours tractor labor are required.

TABLE 2. PIMIENTO PEPPER: USUAL OPERATION, DATES PERFORMED, AND LABOR USED PER ACRE ON FARMS USING MULE AND TRACTOR POWER. PIEDMONT, GEORGIA.*

Operations	Dates performed	Man	Hours of Labor per acre	
			Mule	Tractor
Land preparation and applying fertilizer	Feb. 1 to April 15	6.18	4.17	2.01
Listing and planting	April 1 to May 1	37.82	3.06	0.00
Cultivating and side dressing	April 15 to Sept. 1	53.79	30.17	0.00
Harvesting	Aug. 1 to Nov. 15	48.51	0.00	0.00
Total		146.30	37.40	2.01

*Information obtained from Mimeo Series 12, Georgia Experiment Station. 1950 (10).

The cost of producing an acre of pimiento pepper was $106.54 on farms using only mule power—using rate prevailing in 1948. On farms using both mule and tractor power, the cost per acre was $92.78—Table 3). It is obvious from these data that the pimiento grower must produce yields higher than the State average in order to obtain economical returns.

INSECT PESTS

Although the pimiento crop does not suffer greatly from insect damage, there are a number of pests that take a toll all through the growing season. These are treated in order of attack from plant bed to harvest.

Green Peach Aphid, *Myzus persicae* (Sulz.). Soft green aphids, or plant lice appear on plants in the bed, sucking juice from the leaves and stems and producing honeydew which supports a black mold. If plants are infested when set in the field, the aphids may multiply and stunt the plants. This pest is a common agent in the spread of mosaic disease.

The usual control of aphids on pepper is nicotine spray. Use one pint of nicotine sulphate and four pounds of soap to 100 gallons of

TABLE 3. PIMIENTO PEPPER: USUAL INPUTS AND COST PER ACRE, PIEDMONT, GEORGIA, 1948.*

Item	Unit	Rate[1]	Mule operations		Tractor and mule operations	
			amount	cost	amount	cost
Plants	thousand	$2.00	6[2]	12.00	6[2]	$12.00
Fertilizer	pound	0.022	500	11.00	500	11.00
Side dressing	pound	0.032	225	7.20	225	7.20
Man labor:						
Land preparation and planting	hour	0.30	47.7	14.31	44.0	13.20
Cultivating	hour	0.30	49.2	14.76	53.8	16.14
Harvesting:[3]						
Picking	hour	0.25	34.6	8.65	34.6	8.65
Grading	hour	0.25	8.7	2.18	10.0	2.50
Hauling to market	hour	0.25	18.9	4.72	3.9	0.97
Total			159.1		146.3	
Mule labor:						
Land preparation and planting	hour	0.25	18.6	4.65	7.2	1.80
Cultivating	hour	0.25	25.6	6.40	30.2	7.55
Hauling to market	hour	0.25	39.9	9.97	..	
Total			84.1		37.4	
Tractor labor:						
Land preparation and planting	hour	0.45	....		2.0	0.90
Total					2.0	
Equipment charge				4.20		4.37
Land charge				6.50		6.50
Grand total				$106.54		$92.78

1. Cost rates are based on the average for 1948.
2. Includes plants used for replanting.
3. Based on a normal yield of 3,900 pounds per acre.

* Table from Mimeo Series 12, Georgia Experiment Station. 1950. Harrington, B. J. Pimiento Pepper: Production Practices and Costs, Piedmont, Georgia. (10).

water, or add the nicotine sulphate to 100 gallons of bordeaux mixture without soap. Spray in the middle of the day when the temperature is 70 degrees or above.

More recently this insect has been controlled with TEPP (Tetraethyl pyrophosphate) at the rate of 0.5 pint of 40% TEPP or its equivalent per acre, or parathion spray, 2 pounds of 15% wettable materal per 100 gallons of water. A one percent parathion dust is used for this insect. Listed below are some precautions to be used in applying parathion and TEPP:

1. Special precautions should be taken in handling TEPP and parathion to avoid prolonged contact with the skin or breathing the vapors from either spray or dust.
2. Parathion is highly toxic to human beings. It is poisonous if swallowed, inhaled, or absorbed through the skin. *The precautions printed on the package are for your protection and should be followed carefully.* When applying parathion a respirator should be used to avoid inhaling the material. A dust and vapor type

respirator is suggested and may be obtained from the following companies:

American Optical Company, Southbridge, Mass., Chemical Cartridge Respirator, No. R-5055

Mine Safety Appliance Company, Pittsburgh 8, Pa., Chemical Cartridge Respirator, No. Cr-45779

Wilson Products Company, Reading, Pa., Chemical Cartridge Respirator No. 701

3. Discontinue the use of parathion and TEPP at least two weeks before harvest.

If certain symptoms of illness appear, a doctor should be consulted at once. The antidote (atropine) known to be especially effective in the case of parathion should be carried by those using the chemical, or available for immediate use if needed. See label on containers for symptoms and treatment.

Cutworms, *Feltia subterranea* (F.). Cutworms are often severe on newly set plants, necessitating replanting which delays the establishment of the crop. This damage usually occurs after a winter legume, or on land that was not clean cultivated the previous year. The cutworms feed on green plants or weeds during the fall and winter, then attack whatever crop is planted in the spring.

After the land is prepared and before the pepper is planted, a poison bait should be broadcast to kill the worms. Mix thoroughly one pound of sodium fluosilicate, or paris green, with 25 pounds of bran, then moisten with about three gallons of water. Scatter the bait in the late afternoon, using 25 pounds to the acre. The same bait may be used after pepper is planted, broadcasting in the same way. Do not put on the plants.

Lesser Cornstalk Borer, *Elasmopalpus lignosellus*. (Zell.). One year, newly-set pepper at Experiment was attacked by a small, blue-ringed caterpillar, which is often found in corn and legumes. Pepper stems were tunneled and skinned at ground level and were easily broken by the wind. This occurred on a field which had a winter cover of rye. The only preventive known for this borer is thorough preparation of the soil.

Pale-Striped Flea Beetle, *Systena blanda* Melsh. The leaves of young plants are riddled with small holes and scarified until they wither. In severe cases, buds are also attacked and plants killed. This is done by a brown and white, hopping beetle, one eighth inch long. Outbreaks have usually followed a dry fall and winter. Cryolite spray, one pound to 50 gallons of water, or cryolite dust, using 10 to 15 pounds per acre of a mixture containing 50 percent sodium fluoaluminate is suggested for the flea beetle. Apply to all parts of the plant. In recent years, 10 to 15 pounds per acre of a three to five percent DDT dust has given excellent control of the flea beetle.

Tomato Hornworm, *Protoparce sexta* (Joh.). Occasional fields or parts of fields may be defoliated by large, green worms with white bars on the side and a horned tail. These worms feed on the leaves and sometimes scar the fruit. The same worm is a serious pest of tobacco and related plants, such as tomato and eggplant.

Hand-picking is usually a sufficient remedy for hornworms. Worms which are infested with many white "spines" should be left as these white objects are the cocoons of beneficial parasites. If hornworms are widespread, the field should be dusted or sprayed with cryolite. Use 10 to 15 pounds of cryolite per acre, containing at least 70 percent sodium fluoaluminate, as a dust; or spray with cryolite, 12 pounds to 100 gallons of water.

TDE(DDD) at the rate of 4 pounds of 50 percent wettable powder to 100 gallons of water or a 10 percent dust at the rate of 15 to 30 pounds per acre has given excellent control of this insect.

Pepper Weevil, *Anthonomus eugenii* Cano. This serious pest of pepper was first found in Georgia in the fall of 1946. A survey made by the Georgia Department of Entomology disclosed infestations in 17 counties in the central part of the State. Most of these infestations were very light. However, the weevil destroyed an estimated three-fourths of the crop in one field in Jones County, Georgia during 1946; and it is a major pest of pepper in California and other states which have a milder climate than that existing in central Georgia. Hibernation studies, following the infestation of 1946, have shown that the weevil is unable to live and reinfest pepper planted the following growing season in the latitude of central Georgia; therefore, it will not probably become a major pest of pimiento in this area.

The pepper weevil is similar in appearance and habits to the cotton boll weevil, though it is much smaller. It punctures the blossom buds and small pepper pods, laying eggs in them and causing the fruits to fall prematurely. The grubs feed on the core and inner walls. Newly formed adult weevils make holes in the pod and emerge. The insect is easily spread in infested fruit, on picking sacks, and on young pepper plants.

A generation, from egg to adult weevil, is produced in two to three weeks in southern California (8). There are five to eight generations a year in that region. There, without frost, the insect is active the year round, infesting pepper and nightshade in the winter months.

In California, pepper growers have controlled the weevil by dusting with cryolite, using 15 to 25 pounds per acre of a mixture containing 50 percent sodium fluoaluminate. DDT dust (2% to 5%) at the rate of 15 to 30 pounds per acre is reported to give excellent control of the weevil (12).

Fall Army Worm, *Laphygma frugiperda* (A. & S.), and Corn Earworm, *Heliothis armigera* (Hbn.). In the late summer, medium-sized worms sometimes over-run the fields, eat leaves, and bore into the fruit. They enter the stem end of the peppers, feed on the core, and allow water and rot to enter. Cryolite, DDT, and parathion (1% dust at the rate of 15 to 30 pounds per acre) are recommended insecticides for the control of these insects on pimiento.

Green Stink Bug, *Nezara viridula* (L.), and **Leaf-Footed Plant Bug**, *Leptoglossus phyllopus* (L.). These large insects puncture peppers and suck out the juice causing white pithy spots in the fruit wall. The bugs breed on cowpeas, Jimson weed, bitterweed, and other plants. When cowpeas are cut, the bugs swarm to other crops. DDT or sabadilla dust will kill these pests.

DISEASES

Plant and fruit diseases are chiefly responsible for the low average yields of pimientos in Georgia. Higgins (10), in his discussion of pimiento diseases, (Georgia Experiment Station Bulletin 186) recommends practical control measures which, if closely followed, would do much to increase production. No attempt is made to give the details of each disease; however, it is thought that the attention of the reader should be called to the symptoms of some of the more important diseases, so that they may be recognized, and to give suggested methods for their control.

Damping-Off. This disease is very common and is often quite destructive to young pimiento plants in the seedbed, causing them to decay at the soil line, fall over, and die. Planting the seed in rows far enough apart so that the soil may be stirred after each rain or watering helps in the control of this disease; however, where the soil does not dry readily, a handful of air-slaked lime between the rows will help. Damping-off usually starts in small areas in the plant bed. Early treatment of these areas with Semesan solution (1 ounce to 3 gallons of water, applied at the rate of one quart for each square foot bed space) will aid in its control. Care should be taken to treat at least six inches beyond the infected area to prevent further spread of the disease.

Blue Mold. During certain seasons, blue mold causes extremely heavy damage to pimiento beds in southern Georgia, and has been known to occur in beds in the central part of the State. The disease, because of the spores produced, causes the attacked leaves to take on a bluish color and die, yet older plants in many cases recover. Where the covers have been kept over the beds and the plants are small and tender, the disease often destroys almost the entire bed within two or three days.

The most practical and efficient method for controlling this dis-

ease consists in gas treatment with paradichlorobenzine. The details of this method have been worked out with good results on tobacco by Clayton et al (1). It has been used in southern Georgia, and a large cannery in the State has used it with equally good results on pimiento beds in the same vicinity. The best procedure, which was published by the above workers in United States Department of Agriculture Leaflet No. 209, is to make sure the side walls and ends of the beds are fairly tight. The cloth should be stretched tightly above the plants. For the most effective results, it is essential that the beds be covered with sheeting having at least 56, and preferably 65 threads per inch. Wherever possible, the covers should be wet thoroughly before applying the crystals on the lower strips or cover of tobacco cloth. This increases the vapor-retaining qualities of the cover, and cuts down on the quantity of material necessary. A grade of crystals, known commercially as No. 6, is recommended by the above workers, and it should be applied at the rate of one and one-half pounds per 100 square yards of bed space if the top cover has been soaked with water before the beginning of this treatment, or two and one-half to three pounds for the same area if the cover is dry. The treatment should not be started until about sundown and the beds should be opened about eight o'clock the following morning. The first treatment should be given as soon as the disease is observed in the immediate vicinity of the plant beds. When the weather is fairly warm, two applications should be given each week, but not on successive nights. In cold weather, the treatments should be increased to three per week. As a general rule, from five to 10 treatments are required during the season to keep the disease under control. In fact, good control with little or no injury has been obtained in pimiento beds by sprinkling the crystals on the soil among the plants and then covering them as just described. Indicatons are that pimiento plants are not as easily injured by the materials as are tobacco plants. It is best, however, for the time being at least, to take the same precautions in applying the treatment in pimiento as in tobacco beds. Fermate and some of the newer fungicides are recommended for the control of blue mold on tobacco. Their use is indicated for the control of blue mold on pepper as well, although extensive trials have not been conducted with these materials on pepper.

Southern Blight. Southern blight attacks plants of any age near the soil line, thus causing them to wilt gradually and finally die. The disease is most damaging during periods of hot, dry weather, often killing many mature plants with green, turning and ripe fruits. Two practical methods of control are a carefully planned rotation whereby pimientos will follow some resistant crop such as corn, small grains, or grasses, and the use of special cultural practices. Recent tests with cultural practices to control southern blight on

peanuts and tobacco indicate good results may be obtained by turning the soil so as to completely cover all plant material, and then by shallow, flat cultivations avoid moving any soil to the plants during the growing season.

Cercospora Leaf-Spot. This leaf disease is especially easy to recognize because of the large brown circular spots with typical grayish centers that it causes. It usually attacks the bottom leaves of the plant first and gradually proceeds upward. When infection becomes severe, the leaves turn yellow and drop, thus exposing both the green and ripe fruits to sunscald.

The disease is seed-borne and may be controlled by seed treatment, proper sanitation in the seedbed, and crop rotation. The details of this are discussed under a subsequent heading. Results of spraying tests under field conditions at this Station for several years indicated that this disease may be effectively controlled by any one of the several copper sprays, if applied efficiently at the right time. However, the returns from this operation were not profitable over a period of years.

Bacterial Spot. Bacterial spot attacks both the leaves and fruits, causing dark-brown, wart-like spots. The disease spreads rapidly in wet weather, and if not controlled will cause the plants to shed most of their leaves. The spots on the fruits also allow the entrance of decay organisms and molds which cause the fruits to rot. Seed treatment, seedbed sanitation, and crop rotation or field spraying are the recommended methods for control.

Mosaic. A severe case of mosaic causes plants to become dwarfed, the leaves to crinkle, the fruits to be distorted, and the young flower buds to drop before opening. It may be spread from plant to plant in the field by farm hands at picking time, by aphids, and perhaps other sucking insects. The disease occurs on many other crops and on certain species of weeds. Control of aphids in plant beds, clean cultivation, and field sanitation are the best methods to keep this disease in check.

Blossom-End Rot. Blossom-end rot, as the name implies, affects only the fruits. The disease is physiological in nature, being brought on by an irregular water supply to the plant, and some years seriously affects the early crop by causing pale water-soaked spots to appear near the tip end of the fruits. These spots usually become infected with fungi and turn black. Every effort should be made to conserve soil moisture by proper cultural methods.

Anthracnose. Anthracnose is a disease of pimientos but does not cause nearly the loss to growers as does ripe-rot and bacterial spot. It produces circular, sunken spots on green and red fruits alike. When present in the field, the disease spreads rapidly during wet weather. Saving seed from disease-free fruits and crop rotations are two practical methods for the control of this disease.

Ripe-Rot. Ripe-rot is the most serious fruit disease of pimientos in Georgia. It causes small, yellowish spots to appear on the ripe fruits, which increase in size during damp weather and become sunken and soft. Under favorable conditions, the disease spreads rapidly. In many instances, it may be overlooked at the time the fruits are graded and sacked for delivery, or even after the fruits reach the cannery, but upon being packed in baskets for a few hours waiting to be processed, much of the load may be rendered a total loss because of this disease. Selecting seed from disease-free fruits, planting on new ground each year, and destroying all infected fruits are the recommended methods of control.

Nematode Root-Knot. The pepper plant is quite susceptible to injury by the nematode, a microscopic worm which bores into the young roots and causes swelling and distortion of the roots. Most pepper growers are familiar with the disease. In severe cases the plants are stunted and pale, and appear starved in spite of heavy fertilization. If such plants are dug and examined carefully, the roots are found to be distorted and knotted with swellings of various sizes.

Nematode injury is most serious on the lighter, sandy-type soils. On the heavier soils, the minute worms cannot migrate rapidly, and severe damage to pepper plants rarely occurs except when the plants become infested in the seedbed. However, where pepper or other very susceptible crops are grown on a field year after year, nematodes may become abundant and cause severe damage on the heavier clay soils.

With proper care in selecting seedbed soil and crop rotation, compratively little damage by nematodes may be expected on the clay soils in the Piedmont section of Georgia. More detailed attention must be given these same practices for proper control of nematodes on the lighter soils of the Coastal Plain area.

When plants from other sections are bought, the roots should be examined carefully for root-knot and the entire shipment discarded, if nematode injury is apparent.

ADDITIONAL MEASURES FOR CONTROLLING DISEASES

Seed Treatment. Since many pimiento diseases are seed-borne, seed treatment is necessary. This is an effective and fairly inexpensive means of reducing crop losses from seed-borne diseases, if carried out according to directions. In fact, as the situation now stands in this State, no pimiento seed should be sold by the canners, or planted by the growers, that have not been treated.

Pimiento seed are somewhat sensitive to certain of the more effective disinfecting materials. The best time to treat seed is immediately after they are removed from the fruits. Higgins (10) has tried

many different materials, both organic and inorganic, and has come to the conclusion that Semesan will give the best results. The damp seed should be soaked for 90 minutes in a solution made by dissolving one ounce of Semesan in three gallons of water (1 to 400). The seed should be stirred occasionally while soaking, and when the above treatment time has elapsed, they should be drained, spread out thinly to dry, and then stored in a cool, dry place. When large quantities of seed are to be treated, not more than three lots should be soaked in one container of solution before it is renewed.

Where the seed have been allowed to dry before treating, they should first be soaked about 10 hours in clean water, then placed for five minutes in a solution of copper sulphate (bluestone, one ounce to two quarts of water), drained, rolled in air-slaked lime, and planted at once.

Seed Selection. (See page 7)

Seedbed and Field Sanitation. Sanitation is a very important precautionary measure in helping to control diseases. Where the same beds are used each year for growing plants, the walls should be cleaned and given a good coating of copper naphthenate during the early winter. All old soil should be removed and the beds filled with new soil each year, wherever practical. On the other hand, if this cannot be done, the old soil should either be steam sterilized or else thoroughly disinfected with formaldehyde solution, which is sold commercially as formalin, at least two weeks before planting. Higgins (10) recommends that the beds be well spaded and freed of clods before treatment. Add one gallon of formalin to 99 gallons of water, and apply at least one-half gallon to each square foot of soil with a sprinkling can. Each bed should be covered as soon as the material is applied and left covered for two or three days to prevent the loss of fumes from the soil. When the covers are removed, spade again or plow the soil to hasten the escape of formalin from the soil.

Spraying the young plants in the bed with 4-4-50 Bordeaux mixture, (four pounds of copper sulphate (bluestone), four pounds hydrated lime, and 50 gallons of water) or with any one of several prepared copper sprays is important. The first application should be given soon after the first true leaves appear and the second about two weeks later. Even a third spray applied a few days before setting the plants in the field in some instances will be beneficial.

Where pimientos are grown in the same vicinity year after year, all old plants and fruits should be destroyed or completely plowed under soon after the first killing frost. This will serve to get rid of some of the diseases that winter over in such refuse. Keeping the weeds and grass mowed and the fence corners and permanent terraces burned off will also aid in destroying certain harmful diseases and insects.

SUMMARY AND RECOMMENDATIONS

Georgia ranks first in pimiento acreage and production. Since there has been a general decline in yields for the past few years in this State, there is a need in many instances for growers to adopt better methods of production.

Every possible effort should be made by the grower to plant only good seed, i.e., seed that is clean, viable, free from disease, and true to name. From one-half to one pound of such seed should be sown for each acre that is to be set. For best germination, the seed should be stored in a cool, dry place, until planting time.

There are three general methods used in Georgia for growing plants. (1) The hotbed method which is used when the plants are grown in the Piedmont area, (2) the cold-frame method, and (3) the open-field method, both of which are used by growers and canners in southern Georgia where supplemental heat is not required. Care should be taken to grow plants that are stocky and well hardened for transplanting to the field. The young plants in the bed should be sprayed two or three times with either 4-4-50 Bordeaux or any one of the several commercially prepared copper sprays.

When properly managed, it is possible to produce good yields on almost any of the soil types in the pimiento-growing area of the State. A system of crop rotation should be followed whereby pimientos will not appear on the same field oftener than once in three years. Plants should be set in the field not later than May 1 and spaced from 30 to 36 inches apart in 42-inch rows. Six to eight hundred pounds per acre of a 4-8-8 (N-P-K) fertilizer applied in the drill and mixed well with the soil several days before planting, and then two application of 150 to 200 pounds of a 14-0-14 fertilizer applied as side-dressings, will be sufficient to carry the plants through until frost in central Georgia. On the sandy soils of the southern part of the State often as much as 1,000 pounds of fertilizer may be required to obtain maximum yields.

Shallow cultivation should be practiced at all times. It is important that the crop be kept clean by frequent plowings and hoeings until late summer.

All fruits should be of a dark red color when picked except in extremely wet weather when they might be harvested earlier to prevent cracking.

Insects which damage pimientos in Georgia include aphids or plant lice, cutworms, fall army worms, and tomato hornworms. Methods for their control are discussed. Although the pepper weevil has been found in Georgia, the severe winters make the weevil of minor importance. Where the weevil occurs it is perhaps the most destructive of all pepper insects.

Pimiento diseases more than any other single factor, are responsible for the low average yields of this crop in Georgia. The most important of these diseases include damping-off, blue mold, Cerco-

spora leaf-spot, bacterial spot, mosaic, southern blight, blossom-end rot, anthracnose, and ripe-rot. Recommended methods for the control of these diseases are given.

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